DOE-OE Energy Storage Technology Advancement Partnership (ESTAP) Webinar

Replacing Diesel in an Alaskan Community: Cordova's New Battery Energy Storage System

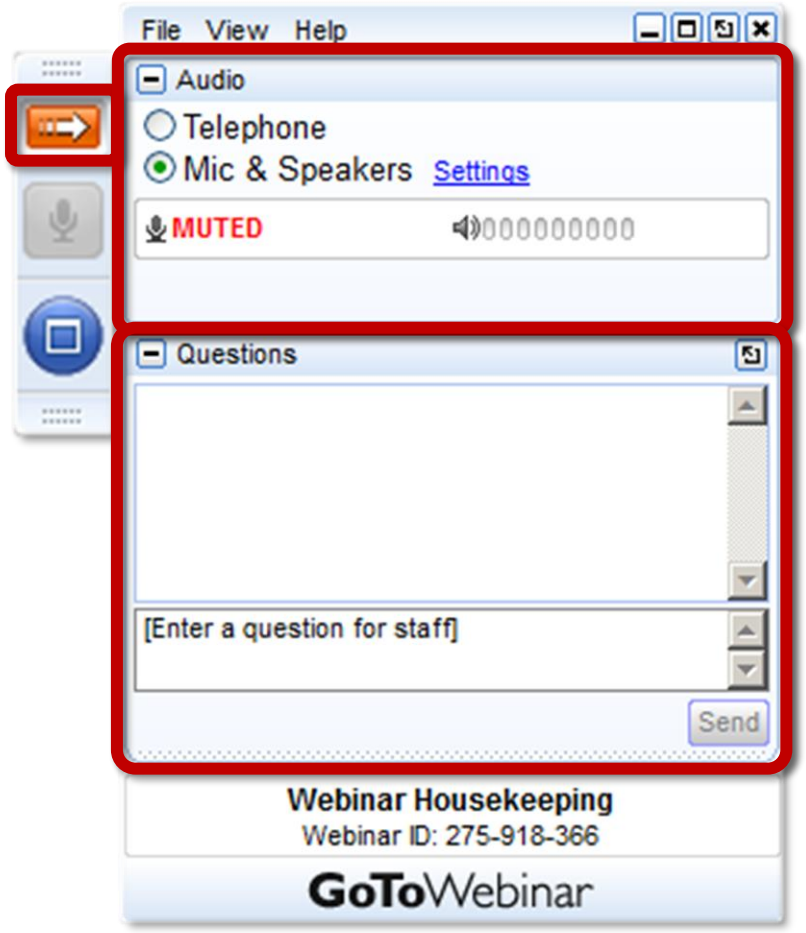
May 7, 2020

U.S. DEPARTMENT OF ENERGY

Sandia National Laboratories

CleanEnergy States Alliance

Housekeeping



Join audio:

- Choose Mic & Speakers to use VoIP
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Use the orange arrow to open and close your control panel

Submit questions and comments via the Questions panel

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DOE-OE Energy Storage Technology Advancement Partnership

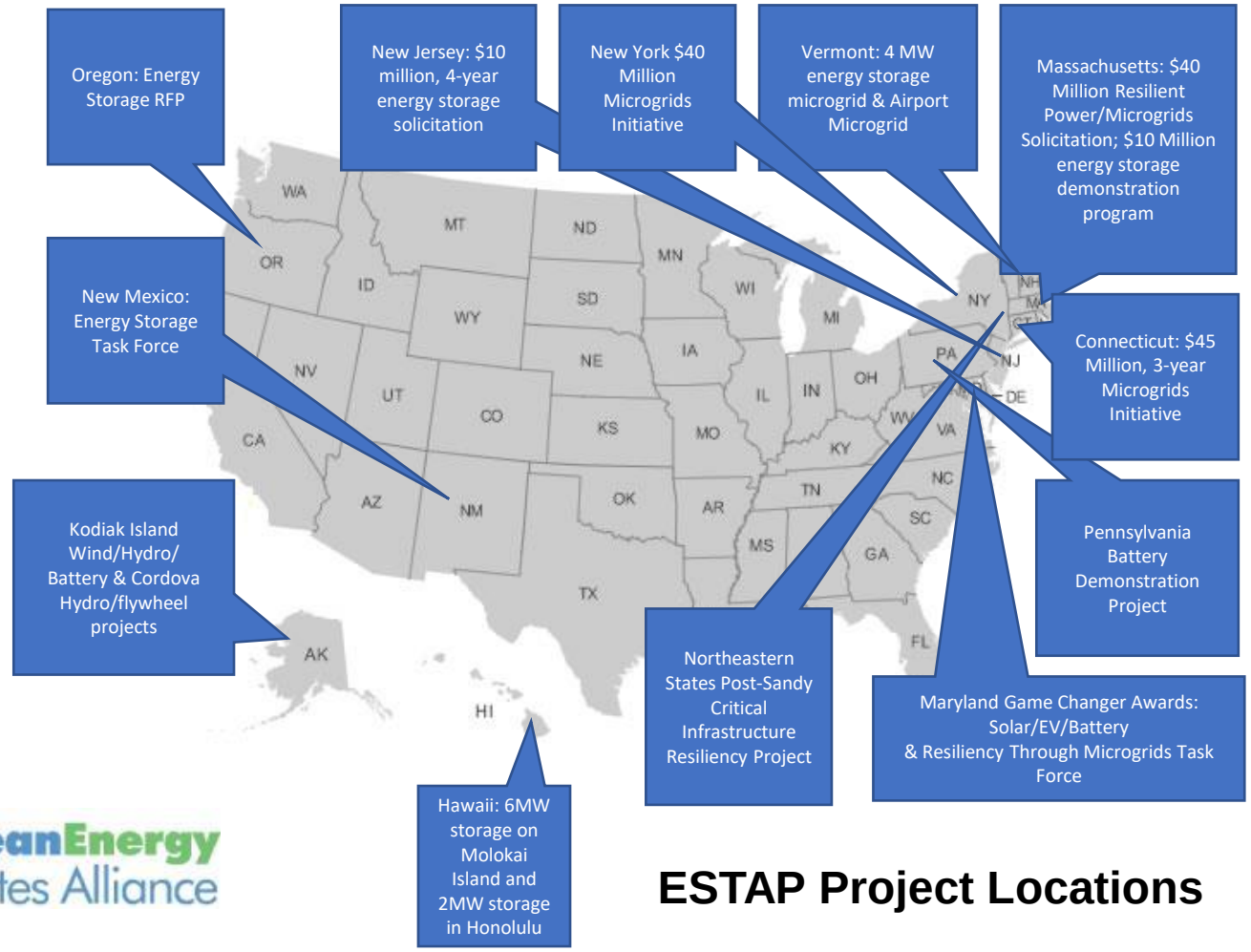
The Energy Storage Technology Advancement Partnership (ESTAP) is a US DOE-OE funded federal/state partnership project conducted under contract with Sandia National Laboratories.

ESTAP Key Activities:

1. Disseminate information to stakeholders
   - ESTAP listserv >3,000 members
   - Webinars, conferences, information updates, surveys.

2. Facilitate public/private partnerships to support joint federal/state energy storage demonstration project deployment

3. Support state energy storage efforts with technical, policy and program assistance



ESTAP Project Locations

Clean Energy States Alliance

CONNECTICUT GREEN BANK

DEPARTMENT OF ENERGY & ENVIRONMENT

EnergyTrust of Oregon

IPA
ILLINOIS POWER AGENCY

Maryland Energy Administration

MASSACHUSETTS CLEAN ENERGY CENTER

MICHIGAN Energy Office

COMMERCE DEPARTMENT

New Hampshire Public Utilities Commission

BPU | New Jersey's cleanenergy njcleanenergy.com program

NEW MEXICO emnrd Energy, Minerals and Natural Resources Department

NEW YORK STATE OF OPPORTUNITY. | NYSERDA

STATE OF RHODE ISLAND Office of Energy Resources

SMUD
Powering forward. Together.

VERMONT CLEAN ENERGY DEVELOPMENT FUND PUBLIC SERVICE DEPARTMENT

DMME Virginia Department of Mines Minerals and Energy

STATE OF WASHINGTON Department of Commerce
Innovation is in our nature.

DOER Massachusetts Department of Energy Resources

OEI
Wisconsin Office of Energy Innovation

CONNECTICUT ENERGY ENVIRONMENT

ILLINOIS COMMERCE COMMISSION ICC

INCLUSIVE PROSPERITY CAPITAL

MassDEP

NREL NATIONAL RENEWABLE ENERGY LABORATORY

COMMISSIONER STEPHANIE GARCIA RICHARD NEW MEXICO STATE LAND OFFICE

OPC-DC
Office of the People's Counsel
ADVOCACY | EDUCATION | PROTECTION

OREGON DEPARTMENT OF ENERGY

PRAIRIE ISLAND INDIAN COMMUNITY

RHODE ISLAND COMMERCE CORPORATION

Smart Electric Power Alliance

www.cesa.org

Thank You:

Dr. Imre Gyuk
Director, Energy Storage Research,
U.S. Department of Energy

Dan Borneo
Engineering Project/Program Lead,
Sandia National Laboratory

Webinar Speakers

- **Dr. Imre Gyuk**, Director, Energy Storage Research, U.S. Department of Energy
- **Clay Koplin**, CEO, Cordova Electric Cooperative, and Mayor of Cordova, Alaska
- **Scott Newlun**, Manager of Generation and Distribution, Cordova Electric Cooperative
- **Nathan Cain**, Power Production Foreman, Cordova Electric Cooperative
- **Dan Borneo**, Engineering Project/Program Lead, Sandia National Laboratory
- **Todd Olinsky-Paul**, Project Director, Clean Energy States Alliance
- **Val Stori**, Project Director, Clean Energy States Alliance (moderator)

U.S. DEPARTMENT OF ENERGY

CEC

Sandia National Laboratories

CleanEnergy States Alliance

This webinar was presented by the DOE-OE Energy Storage Technology Advancement Partnership (ESTAP)

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ESTAP Website: https://cesa.org/projects/energy-storage-technology-advancement-partnership/

ESTAP Webinar Archive: https://www.cesa.org/projects/energy-storage-technology-advancement-partnership/webinars/

U.S. DEPARTMENT OF ENERGY

Sandia National Laboratories

CleanEnergy States Alliance

Upcoming Webinars

100% Clean Energy States and the 100% Clean Energy Collaborative
Monday, May 11, 3-4pm ET

Decarbonizing Electricity: The Critical Role of Firm Low-Carbon Resources
Friday, May 15, 2-3pm ET

Solar for All: The District of Columbia's Innovative Strategy for Low-to Moderate-Income Solar
Wednesday, May 27, 2-3pm ET

Replacing New York City's Dirty Peaker Power Plants with Renewables and Battery Storage
Thursday, May 28, 1-2:30pm ET

Read more and register at: www.cesa.org/webinars

Grid Scale Energy Storage, for Resilience, Stability, and a Greener Grid

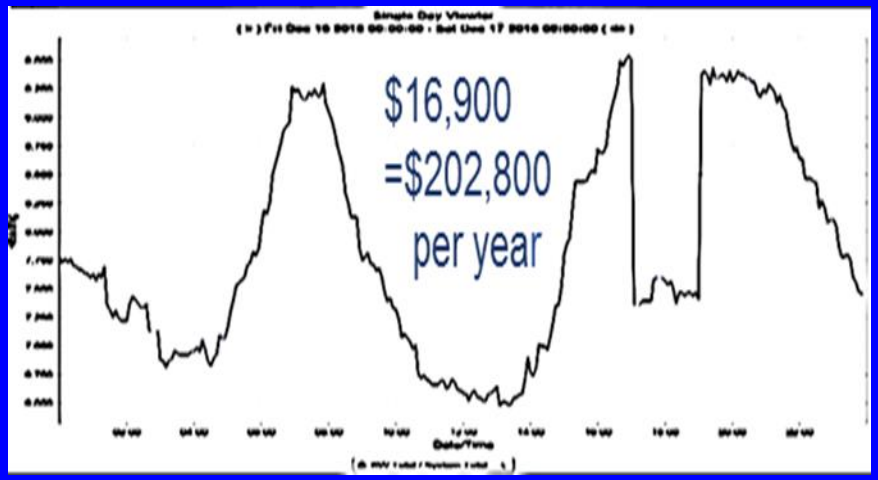
IMRE GYUK, DIRECTOR,
ENERGY STORAGE RESEARCH, DOE-OE

Building Business Cases with Energy Storage:

Wind, Water, and Sun!

Sterling, MA: Microgrid/Storage Project

DOE-OE Collaboration with
Sterling Municipal Light Department.



Ribbon Cutting: October 2016
Commissioning: December 2016

Reducing Monthly and Yearly Peaks:

Chart: Carina Kaainoa

April 2019: 1 million Avoided Cost!

Visitors: Germany, Switzerland, Denmark, Sweden, England, Ireland, Australia, Japan, Malaysia, Taiwan, Brazil, Chile, …. Thailand

Cordova, Alaska – Pop. 2,239

Pamela Smith

Copper River Salmon
World's Finest Salmon!

Cordova Electric Cooperative Collaboration with DOE-OE

Clay Koplin, CEO

Total Generating Capacity:

6MW + 1.25MW Hydro; 2x 1MW Diesel

0.5MW Deflected as Spinning Reserve

Hydro: $0.06/kW; Diesel: $0.60/kW

1 MW / 1 hr Li-ion Storage by SAFT

On ancient Eyak Land

Ribbon Cutting with Sen. Murkowski

Commissioned June 7, 2019

- Frequency Regulation – Replace Diesel
- Load following – Make Hydro Dispatchable
- Emergency Supply – Resilience
- Diesel Arbitrage, Preheating dormant Diesels

National Scope - Local Relevance!

- ABQ Public Schools: demonstrate economic & resilience benefits of ES available to public schools. 13 high schools, 140 campuses.
- Project with Picuris Pueblo, NM to install storage in combination with solar for “Energy Independence”.
- Iowa: Develop 6-8 hour backup for existing/planned renewables
- 3 projects involving Rural Co-ops and Military Reservations.
- Levelock Village, AK. Tech assistance for ES microgrid
- Puerto Rico: 5 town consortium to form Central Mountain micro-grid powered by 250MW solar and hydro with 75 MW storage backup

Energy Storage
should be in
the Toolbox of every Utility!

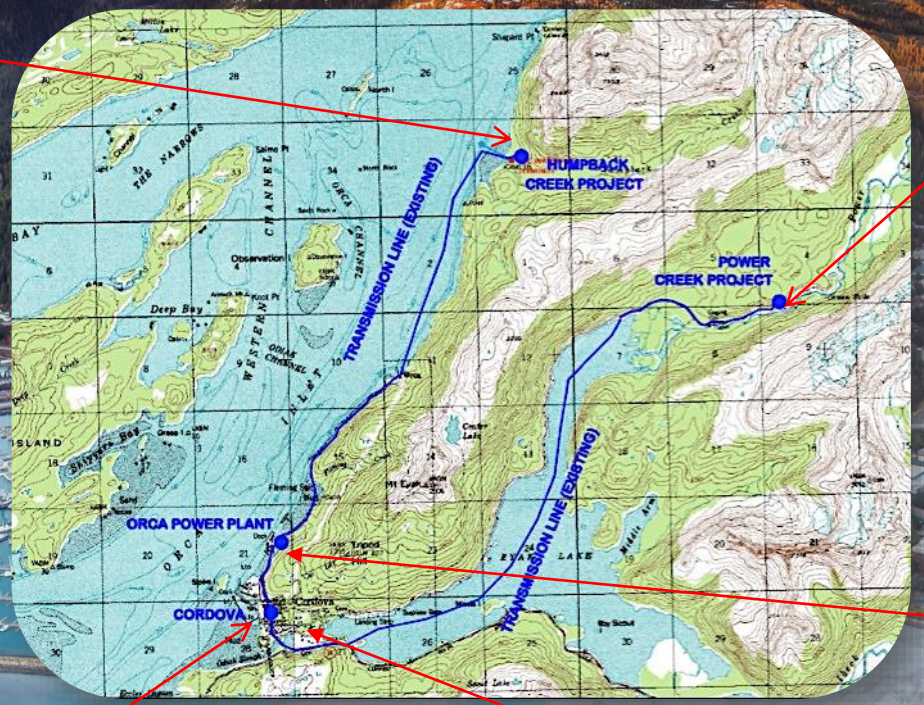
BESS Application in a Microgrid - Cordova Electric Cooperative

Energy Storage Technology Advancement Partnership (ESTAP)
DOE-OE-ES / Sandia / CESA / CEC Webinar
May 07, 2020

Cordova, AK (aerial view)

Cordova Electrical Grid

Humpback Creek Hydroelectric Plant
1250kW (2 x 500 kW + 1 x 250 kW)
17,000 foot UG and submarine transmission line



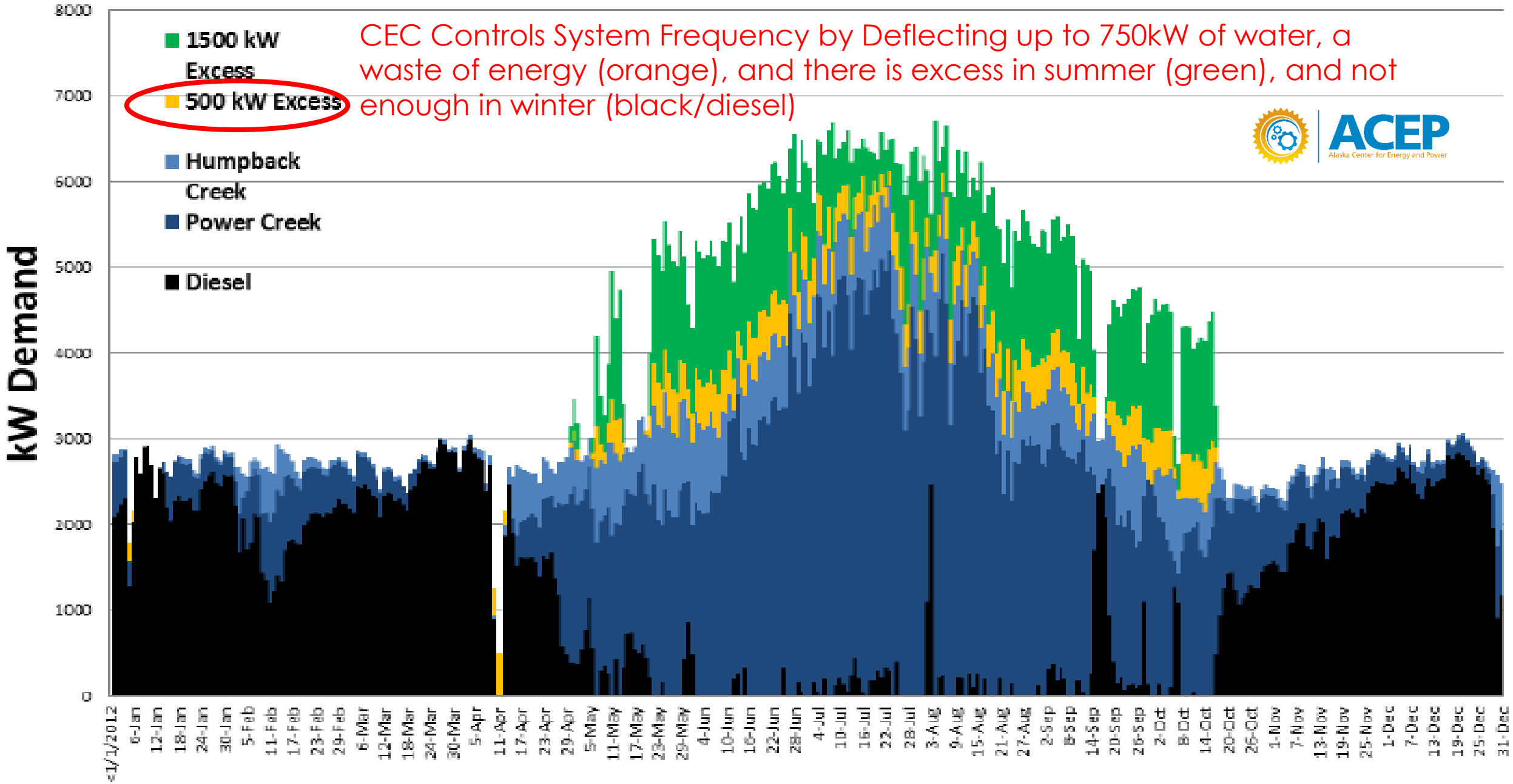
Power Creek Hydroelectric
6278kW (2 x 3124 kW)
25 kV transmission ties to Eyak Substation, Inflatable dam

City of Cordova
1,566 customers, 18MW
One Substation
78mi UG distribution lines

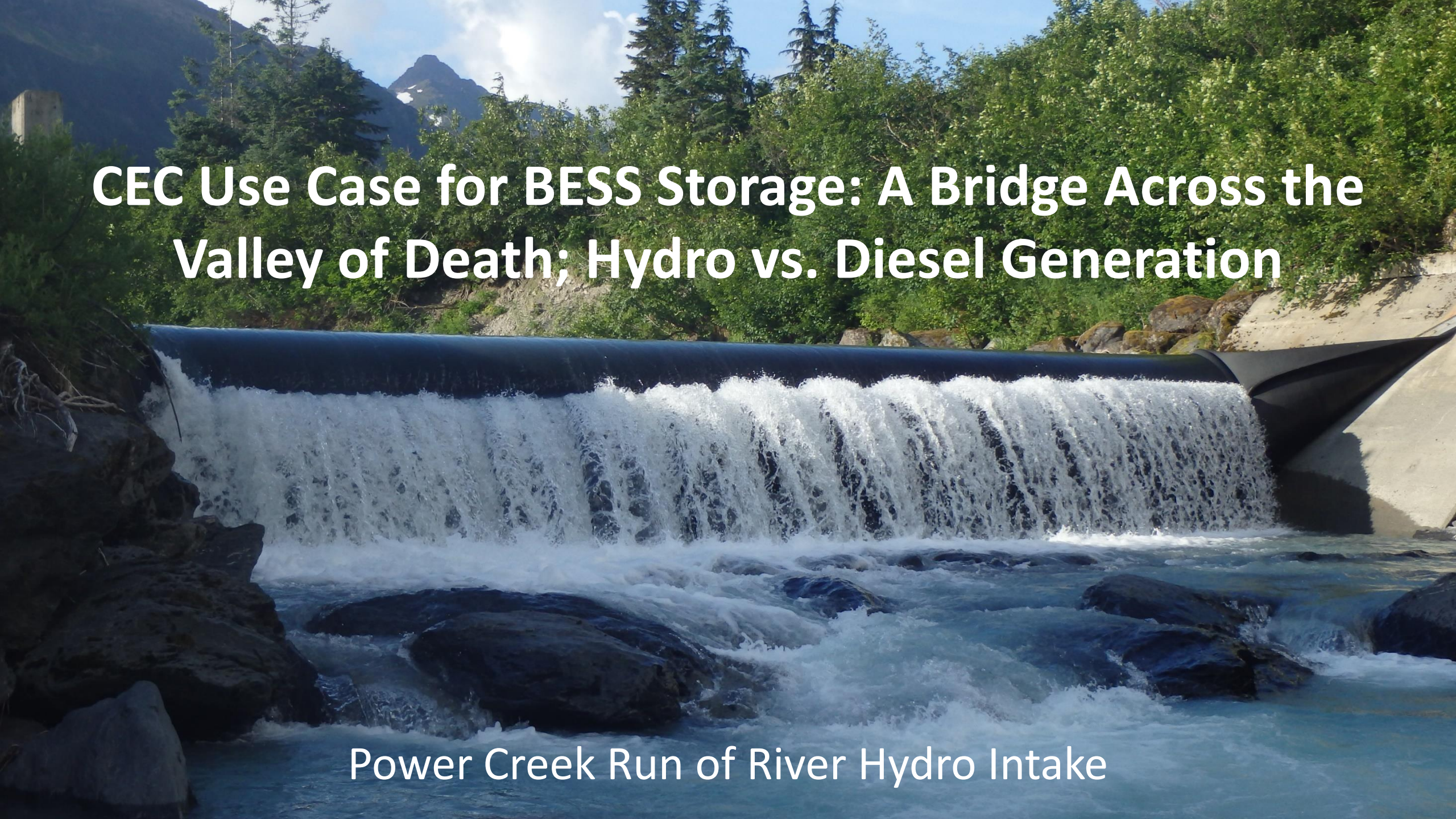
Battery Energy Storage System
1 MW, 1MWh
ABB/SAFT at Eyak Substation

Orca Power Plant
10.8 MW Diesel
Control Center, CEC

Avg Daily kW Load 2012 w/ Excess Hydro



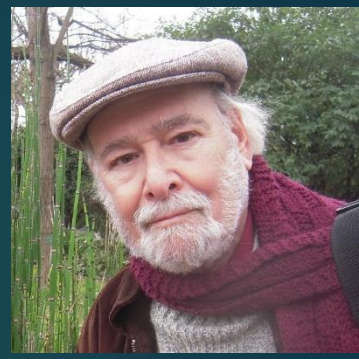
CEC Use Case for BESS Storage: A Bridge Across the Valley of Death; Hydro vs. Diesel Generation



Power Creek Run of River Hydro Intake

A US Department of Energy Sponsored Microgrid Battery Energy Storage Application

(Dr. Imre Gyuk, Director of Energy Storage Research, Office of Electricity)



PARTNERS: US DEPT OF ENERGY-SANDIA-NRECA-ACEP-CEC-CESA; SAFT/ABB PACKAGE

NRECA America's Electric Cooperatives

CleanEnergy States Alliance

Office of ELECTRICITY

ABB

Sandia National Laboratories

ACEP Alaska Center for Energy and Power

CEC

SAFT

Battery Energy Storage – Vendor Choice

SAFT-ABB PACKAGE

Site Work – May/June 2019

RIBBON CUTTING

June 7, 2019

Dr. Imre Gyuk, Project Champion

Dedicated to the community of Cordova, and the
Members of Cordova Electric Cooperative, Inc.

Cordova Battery Energy Storage System

June 7, 2019

With appreciation to Dr. Imre Gyuk, Director of Energy Storage Research, Office of Electricity, U.S. Department of Energy, U.S. Senator Lisa Murkowski, The Alaska Center for Energy and Power (UAF) Gwen Holdmann, Sandia National Laboratories, Pacific Northwest National Laboratory, National Rural Electric Cooperative Association, CoBank, SAFT America Thomas Ebel, ABB Rob Roys, Electric Power Systems, Wilson Construction, Peterson Welding, Alpine Diesel, Samson Tug and Barge, and CEC Staff.

Owner: CORDOVA ELECTRIC COOPERATIVE, INC.

W. Scott Pegau, Chairman
Joe Cook, Vice Chairman
Alexis Cooper, Secretary/Treasurer
Patience Faulkner, Board Member
Kara Johnson, Board Member
Debra Srb, Board Member
Stephen Phillips, Board Member

Clay Koplin, Chief Executive Officer
Emma Merritt, Manager of Administration & Finance
Scott Newlun, Manager of Generation & Distribution
Barbara Bailer, Executive Assistant/HR Coordinator
Craig Kuntz, Project & Technology Coordinator

Partners:

Supportive Funding: US Department of Energy, Imre Gyuk, Stationary Energy Storage Program Director
Technical Consultant: Sandia National Laboratories, Daniel Borneo, Program/Project Lead
BESS System Modeling: Alaska Center for Energy and Power (UAF), Jeremy Vandermeer
BESS System Modeling, Procurement and Optimization: Sandia National Laboratories, Ben Schenkman
Project Manager: Electric Power Systems, Jack Anderson, PE
Project Engineer: Electric Power System, Dan Rogers, PE
Project Integration Engineer: Electric Power Systems, Trever Kudrna, PE
SAFT Project Manager: SAFT America, Gerald Mengelkoch
ABB Project Manager: ABB, Anders Holm
BESS Optimization and Integration: Pacific Northwest National Laboratory, Patrick Balducci
Technical Support and Procurement: National Rural Electric Cooperative Association, Venkat Banunarayanan
Site Preparation and Foundations: Wilson Construction, John Baenen
Equipment Placement: Alpine Diesel, Jerry Blackler and Samson Tug and Barge, Eric Warga
Metal Fabrication: Peterson Welding, Jesse and Jacob Peterson, Marty Bossie
Financing Provided By: CoBank, Jake Good
Electrical Installation: CEC Line Crew; Jeff Field, Terry Long, Ben Simpler, Frank Johnson
Controls and Communication: CEC Power Production: Scott Newlun, Nate Cain, Craig Kuntz

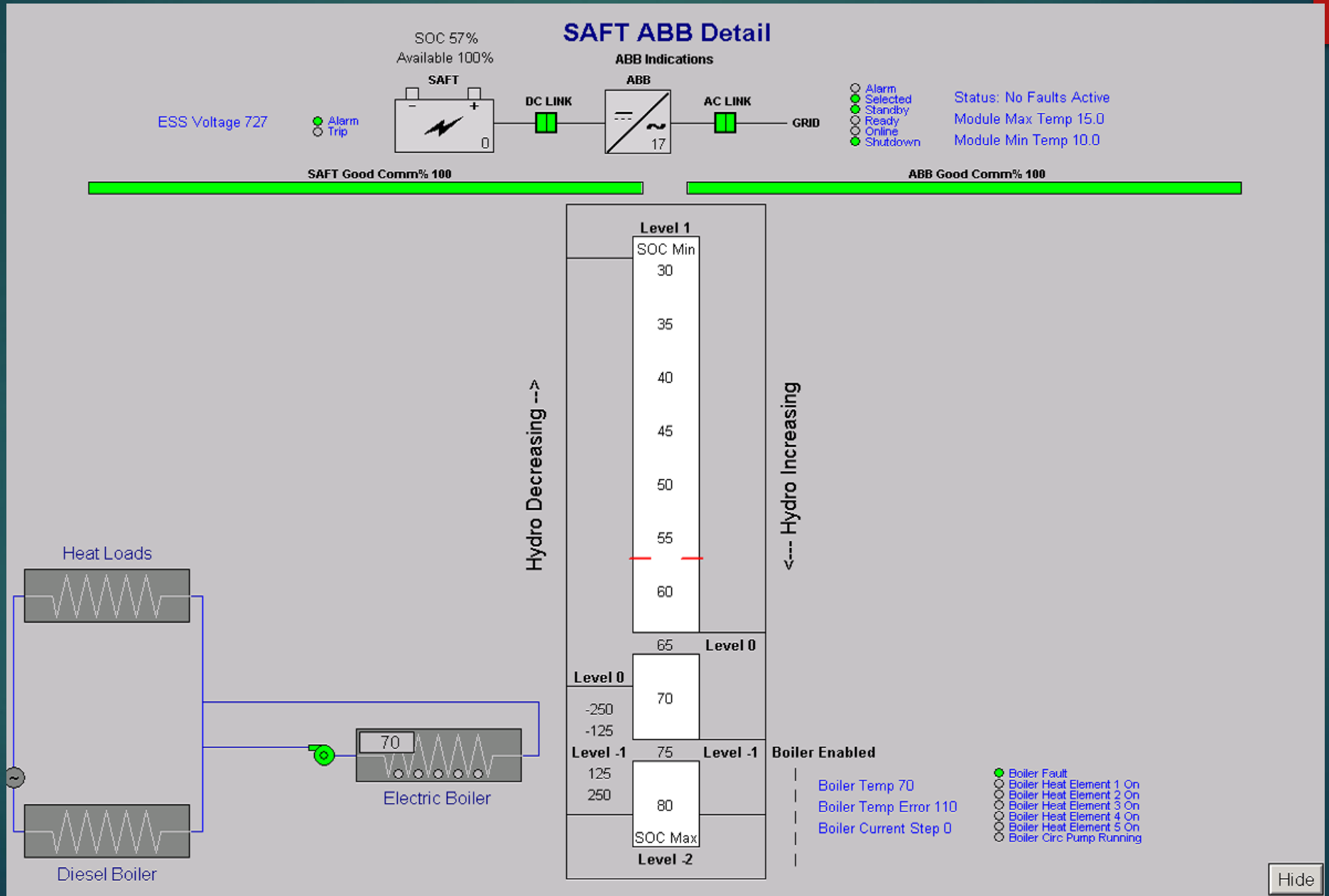
INSTALLATION / COMMISSIONING

July 2019 – Manual Operations Commence

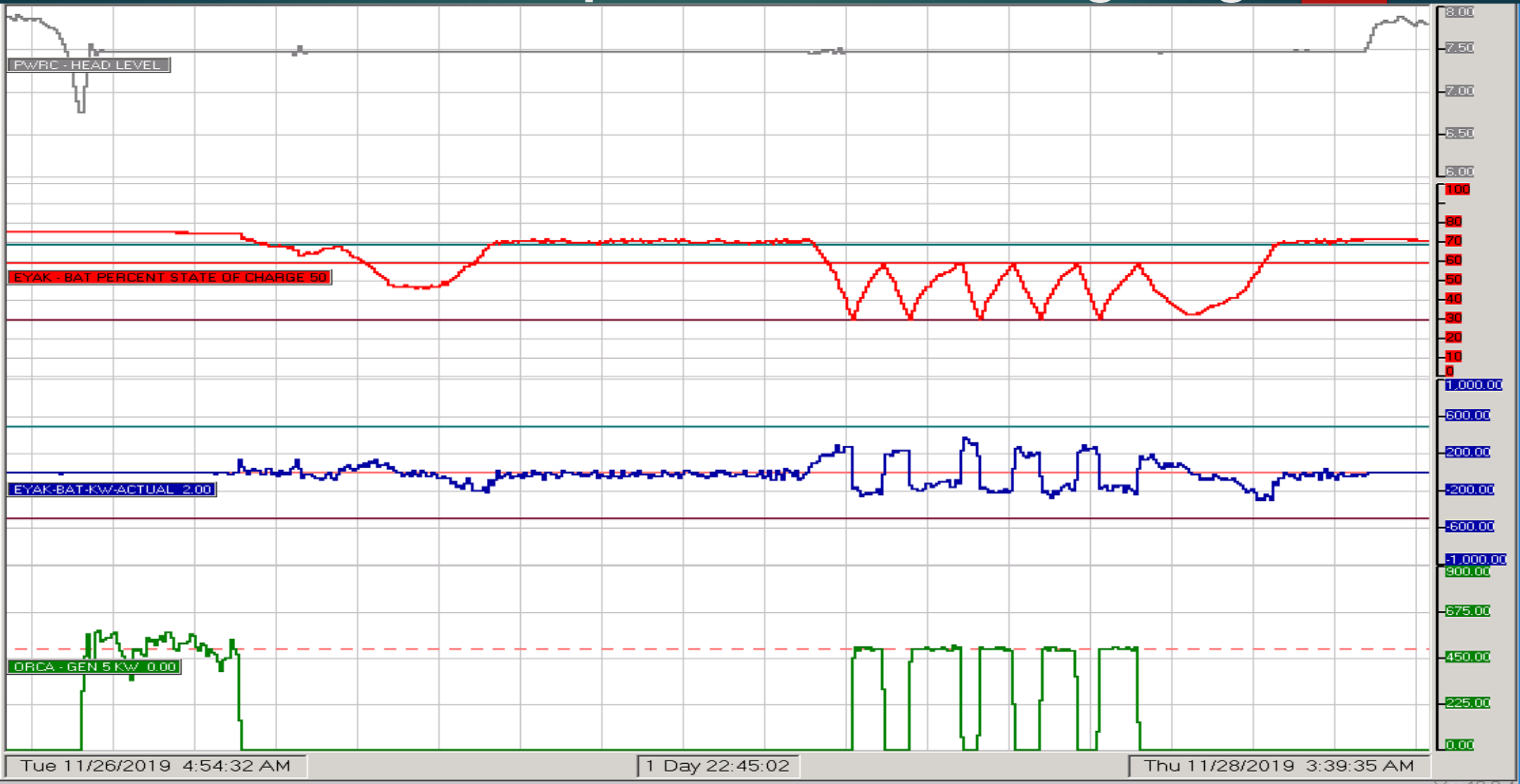
TIMELINES

- 2007 – CEC System Loads Exceed Hydro Capacity and diesel peaking creates a "valley of death"
- 2012 – CEC partners with ACEP and recognizes the benefits of energy storage to CEC Grid
- 2015-16 ACEP Approaches Dr. Gyuk with CEC use case/opportunity and rich CEC data set
- 2016 Dr. Gyuk initiates phase 1 modelling of CEC energy storage via Sandia Laboratories
- 2017 Modelling and analysis indicates a right-sized, right-located Lithium Ion solution for CEC
- 2018 Dr. Gyuk sponsors phase 2 specification and procurement of BESS
- October 2018 CEC BESS Ordered
- May 2019 BESS arrives on site
- June 2019 BESS Installed
- July 2019 BESS Operational
- November 2019 Fully integrated and automated, saves $10,000 over 2-day Thanksgiving Holiday
- November CEC achieves 94% hydro crushing all previous records
- December 2019 CEC achieves 86% hydro crushing all previous records
- April 2020 CEC goes 100% hydro 3 weeks early and starts automated electric boiler heating
- Today: CEC is 100% hydro and heating diesel generators with excess hydro due to BESS

BESS OPERATIONS - CEC



CEC BESS Operations - Thanksgiving



CEC BESS – Preliminary Valuation

- Precise quantitative measures are complex
- CEC Preliminary analysis indicates that at $3.00/gallon, fuel is only half the savings – diesel runtime variable costs are significant
- CEC automated measurement of "valley of death" hours where the BESS balances the grid to keep diesels off
- Year to date "valley of death" is 105 hours for 2020
- CEC estimates a cost savings of $500/hour or $52,500 YTD 2020
- This does not include boiler fuel or other savings
- We just started full battery operations 2 weeks ago

Battery kWh Metering

	Current Values					End of Hour				End of Day			End of Month		End of Year
	Acc Value	Hr to Date	Day to Date	Month to Date	Year to Date	Hr to Date	Day to Date	Month to Date	Year to Date	Day to Date	Month to Date	Year to Date	Month to Date	Year to Date	Year to Date
Bat Out	769	0	0	415	3491	0	0	415	3491	0	415	3491	3076	3076	0
Bat In	3591	7	70	2308	11716	9	63	2301	11709	206	2238	11646	9408	9408	0
Bat %Eff		0.00	0.00	17.98	29.80	0.00	0.00	18.04	29.81	0.00	18.54	29.98	32.70	32.70	0.00

Battery Savings

	Current Values					End of Day			End of Month		End of Year
	Acc Value	Day to Date	Month to Date	Year to Date		Day to Date	Month to Date	Year to Date	Month to Date	Year to Date	Year to Date
Battery	105:20:15	0	26	105		0	26	105	79	79	0

Preliminary CEC BESS Financials Early Takeaways

- "Likely" scenario was 35,000 gallons fuel savings, trending toward 70,000
- "Likely" Battery life was 15 years – the CEC use case gets the highest value from grid balancing which requires little capacity – trending toward 30-year life
- Diesel non-fuel variable costs are significant: lube oil, rebuild hours, regular and emergency maintenance on a per-hour basis are very high from CEC historical records, whereas hydro maintenance and run time hours are an order of magnitude lower
- Data capture and analysis have been delayed by technical and logistical (COVID-19) challenges – a pending site visit will complete this task as travel restrictions ease, paving the way for Sandia to quantify economic and operational measures
- PNNL is working with Alaska Center for Energy and Power and CEC to continue to optimize economic value streams as emergency hospital generation, etc.

Funding and Technical Partners
DOE OE - ES

CEC	$1,025,000
SANDIA (Not Including Modeling)	$ 500,000
PNNL	$ 325,000
Total Project Funding	$1,850,000

- Project Champion: Imre Gyuk, DOE/OE/Energy Storage

- Technical Partners: Department of Energy, Sandia Labs, PNNL,CEC, Alaska Center for Energy and Power, NRECA, SAFT, ABB, Electric Power Systems and now CESA advocacy/technical transfer

Here is What We Learned About BESS…

- Calendar aging capacity loss of 1.5% per year, our chemistry is estimated at 0.5%
- Capacity loss is kWh; kW remains near constant, round trip DC efficiency drops slightly
- Deep cycling causes rapid loss of life, shallow cycling extends life and total kWh throughput by a factor of 100; from 5GWh to 500GWh (or more) in our case.
- Frequency controls (small charges/discharges) can occur while bulk charging/discharging
- Removal, recycling, replacing a full battery set can cost 60% of initial package cost.
- Delivery times are fairly short, < 12 mo. From award to receipt
- Factory warranties and required annual maintenance are expensive
- Control algorithms are complex!
- Integration into a microgrid is costly and complex
- Improvements can be expected through careful monitoring and iterative optimizations
- CEC is Smashing Previous Hydro Records – 95% Hydro in November, 84% in December


Questions?